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ABSTRACT

Using Cattell's Profile Similarity Coefficient, 154 high school football players from 21 different public high schools were classified as being successful or unsuccessful. Seventeen physical and motor ability variables relating to athletic ability were administered to the football players. The variables included: (1) standard height; (2) body weight; (3) calf girth; (4) thigh girth; (5) chest girth; (6) upper arm girth; (7) back lift strength; (8) leg lift strength; (9) right grip strength; (10) left grip strength; (11) bar dips; (12) 40-yard dash; (13) Illinois Agility Run; (14) standing broad jump; (15) total body reaction; (16) 60-yard shuttle run; and (17) football throw for distance. After measuring the variables for each subject, the variables were then subjected to Cattell's Profile Similarity Coefficient. Results show that the 17 variables used were effective determinants of the coaches' classification of successful and unsuccessful football players and that successful football players are taller, heavier, and stronger than unsuccesful football players. (JM)

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THE USE OF CATTELL'S PROFILE SIMILARITY COEFFICIENT IN THE CLASSIFICATION OF FOOTBALL ATHLETES

A Research Paper Presented
at the Research Section
FAHPER CONVENTION
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INTRODUCTION

THE INABILITY TO AGREE AS TO WHICH MEASURABLE TRAITS CAN BE USED TO DIFFERENTIATE BETWEEN SUCCESSFUL AND UNSUCCESSFUL ATHLETES IS A MAJOR SHORTCOMING IN ATHLETIC ABILITY RESEARCH. THE CRUX OF THE PROBLEM APPEARS TO BE IN THE USE OF METHODOLOGIES AND THE STATISTICAL TOOL TO IDENTIFY SALIENT COMPONENTS OF THE ATHLETES.

THE LITERATURE DEALING WITH ATHLETIC ABILITY IS VERY LARGE AND VERY INCONCULSIVE. IN A STUDY OF SUCCESSFUL AND UNSUCCESSFUL ATHLETES, SHELLEY (1960) PRESENTED A DIVERSE CONFIGURATION OF ABILITY TRAITS WHICH CONTRIBUTED TO SUCCESSFUL ATHLETIC PERFORMANCE. HE POINTED OUT THAT SKILL AND STRENGTH WERE THE ESSENTIAL QUALITIES OF AN ATHLETE. HE ALSO CONCLUDED THAT SUCCESSFUL FOOTBALL PLAYERS WERE SUPERIOR TO OTHER ATHLETES OF THEIR OWN AGE IN SUCH ABILITY TRAITS AS: (1) MATURITY; (2) HEIGHT; (3) WEIGHT; (4) UPPER ARM GIRTH; (5) CALF GIRTH; (6) ROGERS' STRENGTH INDEX; (7) ROGERS' PHYSICAL FITNESS INDEX; AND (8) ROGERS' ARM STRENGTH SCORE.

IN ANOTHER STUDY TO IDENTIFY SALIENT COMPONENTS OF SUCCESSFUL FOOTBALL PLAYERS, WILHELM (1951) ADMINISTERED 44 TEST ITEMS TO 65 COLLEGE FOOTBALL PLAYERS AND 65 NON-FOOTBALL PLAYERS. THE INVESTIGATOR IDENTIFIED 25 PHYSICAL AND MOTOR VARIABLES WHICH DIFFERENTIATED BETWEEN FOOTBALL PLAYERS FROM NON-FOOTBALL PLAYERS. HE CONCLUDED THAT SUCCESSFUL FOOTBALL PLAYERS WERE STRONGER AND POSSESSED GREATER SPEED AND AGILITY THAN NON-SUCCESSFUL FOOTBALL PLAYERS.

ADDITIONAL INVESTIGATORS HAVE EXAMINED THE ATHLETIC ABILITY OF FOOTBALL PLAYERS AND MANY OF THESE HAVE USED LARGELY A CRITERION TO ESTIMATE AN EFFECTIVE PROFILE FOR THE SUCCESSFUL ATHLETE. SUCH AN APPROACH ASSUMES THAT ALL DATA VARIATION CAN BE ADEQUATELY EXPRESSED ALONG A SINGLE CONTINUUM OR

LINEAR FUNCTION. THE VALIDITY OF THIS ASSUMPTION IS QUESTIONABLE. THERE HAS BEEN CONSIDERABLE REFLECTIVE JUDGMENT CONCERNING THE ATTRIBUTES OF SUCCESSFUL ATHLETES. NEVERTHELESS, REPORTS WRITTEN BY VARIOUS INVESTIGATORS HAVE MADE FREQUENT REFERENCE TO ATTRIBUTES AND IMPLIED THAT CERTAIN PHYSICAL AND MOTOR VARIABLES ARE MORE PREVALENT IN THE SO-CALLED SUCCESSFUL ATHLETE THAN IN THE UNSUCCESSFUL ONE. PERHAPS, THE MOST NOTABLE FINDING TO EMERGE FROM SOME OF THESE REPORTS IS THE LACK OF A CONSISTENT TECHNIQUE TO DIFFERENTIATE BETWEEN PROFILES OF THE SUCCESSFUL AND UNSUCCESSFUL ATHLETES.

THE IMPORTANCE OF MULTIVARIATE RATHER THAN BIVARIATE DESIGN IS NOWHERE MORE CLEARLY DEMONSTRATED THAN IN ATHLETIC ABILITY RESEARCH WHICH CONCERNS ITSELF WITH TWO GROUPS BUT FAR MORE THAN TWO VARIABLES. SEVERAL INVESTIGATIONS, PARTICULARLY IN CLINICAL AND SOCIAL PSYCHOLOGY, DEAL WITH SIMILARITY BETWEEN PROFILES OF TEST SCORES. SUCH STUDIES, HOWEVER, VARY WIDELY WITH REGARD TO THE PROBLEMS POSED AND THE SPECIFIC VARIABLES USED, BUT THEY HAVE IN COMMON AN ATTEMPT TO DEAL WITH SEVERAL PERSONALITY VARIABLES SIMULTANEOUSLY. INVESTIGATORS SUCH AS FOSTER (1973), RUSHALL (1970), AND KROLL (1969) HAVE ATTEMPTED TO IDENTIFY TYPES OF ATHLETES WHO HAVE SIMILAR CONFIGURATIONS OF PERSONALITY TEST SCORES.

WHILE THE PROCEDURES IN MANY OF THE STUDIES OF PROFILE SIMILARITY ARE VARIED AND INVOLVE THE PSYCHOLOGICAL DOMAIN, THERE IS A PAUCITY OF STUDIES UTILIZING PSYCHOMOTOR VARIABLES IN PROFILE SIMILARITY STUDIES.

BROADLY, THERE ARE TWO WAYS OF REACHING A DECISION FROM A GIVEN ATHLETE'S PROFILE ON AN ARRAY OF PHYSICAL AND MOTOR VARIABLES, CONCERNING THE ATHLETE'S SUITABILITY OR CLASSIFICATION. THE EFFECTIVENESS ESTIMATE IS ONE METHOD WHERE A QUANTITATIVE VALUE ON SOME CRITERION IS ESTIMATED BY A FUNCTION OF TEST SCORES. IN MOST CASES A WEIGHTED LINEAR COMPOSITE IS USED TO ESTIMATE THE EFFECTIVENESS OF THE ATHLETE.

ANOTHER METHOD TO REACH A DECISION FROM A GIVEN ATHLETE'S PROFILE ON AN ARRAY OF PHYSICAL AND MOTOR VARIABLES IS THE ADJUSTMENT OF BELONGINGNESS CALCULATION. THE BELONGINGNESS CALCULATION METHOD ASSUMES THAT AN ATHLETE IS ASSIGNED MORE OR LESS TO CERTAIN DISCRETE TYPES OR WHO IS ASSIGNED BY A COACH TO A SELECTIVE GROUP.

BY MAKING CERTAIN STATISTICAL ASSUMPTIONS, IT IS POSSIBLE TO DERIVE AN EFFECTIVENESS ESTIMATE EQUATION FROM AN ATHLETE'S PROFILE, BUT THE ASSUMPTIONS ARE PROBABLY NOT THOSE WHICH A COACH WOULD LIKE TO MAKE IF HE CAN AVOID THEM.

PURPOSE

IT IS WITH THIS RATIONALE AND USE OF THE CATTELL'S PROFILE SIMILARITY COEFFICIENT TO CLASSIFY SUCCESSFUL AND UNSUCCESSFUL FOOTBALL PLAYERS THAT THIS STUDY IS CONCERNED. MOREOVER, THIS STUDY PROPOSED TO ANSWER THE FOLLOWING QUESTIONS:

1. HOW SIMILAR ARE SUCCESSFUL AND UNSUCCESSFUL FOOTBALL PLAYERS ON ON AN ARRAY OF PHYSICAL AND MOTOR ABILITY VARIABLES AFTER BEING CLASSIFIED INTO ONE OF TWO POPULATIONS?
2. HOW HOMOGENEOUS ARE THE MEMBERS OF THE SUCCESSFUL FOOTBALL PLAYERS ON AN ARRAY OF PHYSICAL AND MOTOR ABILITY VARIABLES.
3. HOW HOMOGENEOUS ARE THE MEMBERS OF THE UNSUCCESSFUL FOOTBALL PLAYERS ON AN ARRAY OF PHYSICAL AND MOTOR ABILITY VARIABLES?

PROCEDURES

THE FOOTBALL COACHES FROM 21 PUBLIC HIGH SCHOOLS CLASSIFIED A SAMPLE OF 154 ATHLETES INTO ONE OF TWO POPULATIONS WHICH WERE IDENTIFIED AS SUCCESSFUL AND UNSUCCESSFUL FOOTBALL PLAYERS. THE CRITERIA USED TO IDENTIFY SUCCESSFUL ATHLETES WERE AS FOLLOWS:

SUCCESSFUL FOOTBALL PLAYERS: A SUCCESSFUL FOOTBALL PLAYER WAS DESIGNATED BY THE RESPECTIVE COACHES AS HAVING: (1) MADE AN ALL DISTRICT OR ALL STATE TEAM; (2) RECEIVED AN ATHLETIC SCHOLARSHIP; (3) POSSESSED EXCEPTIONAL PLAYING ABILITY, MADE THE FIRST TEAM AND WHOSE PERFORMANCE MET OR EXCEEDED THE COACHES EXPECTATION AT LEAST 70 PERCENT OF THE TIME; OR FINISHED IN THE TOP FIVE PLACES IN FOOTBALL STATISTICS AT LEAST 70 PERCENT OF THE TIME.

UNSUCCESSFUL FOOTBALL PLAYERS: AN UNSUCCESSFUL FOOTBALL PLAYER WAS ONE DESIGNATED BY THE RESPECTIVE COACHES AS NOT HAVING: (1) AVERAGE OR EXCEPTIONAL PLAYING ABILITY, DID NOT MAKE FIRST TEAM, AND WHOSE PERFORMANCE DID NOT MEET THE COACHES' EXPECTATIONS AT LEAST 10 PERCENT OF THE TIME; PLAYED IN LESS THAN TWO GAMES; OR DID NOT FINISH THE FOOTBALL SEASON.

ON THE BASIS OF PRELIMINARY REVIEW OF THE LITERATURE, 17 PHYSICAL AND MOTOR ABILITY VARIABLES RELATING TO ATHLETIC ABILITY WERE SELECTED AND ADMINISTERED TO THE FOOTBALL PLAYERS. THE SELECTED VARIABLES INCLUDED WERE: (1) STANDING HEIGHT ; (2) BODY WEIGHT; (3) CALF GIRTH; (4) THIGH GIRTH; (5) CHEST GIRTH; (6) UPPER ARM GIRTH; (7) BACK LIFT STRENGTH; (8) LEG LIFT STRENGTH; (9) RIGHT GRIP STRENGTH; (10) LEFT GRIP STRENGTH; (11) BAR DIPS; (12) 40 YARD DASH; (13) ILLINOIS AGILITY RUN; (14) STANDING BROAD JUMP; (15) TOTAL BODY REACTION; (16) 60 YARD SHUTTLE RUN; AND (17) FOOTBALL THROW FOR DISTANCE. THE 17 VARIABLES WERE SUBJECTED TO CATTELL'S PROFILE SIMILARITY COEFFICIENT.

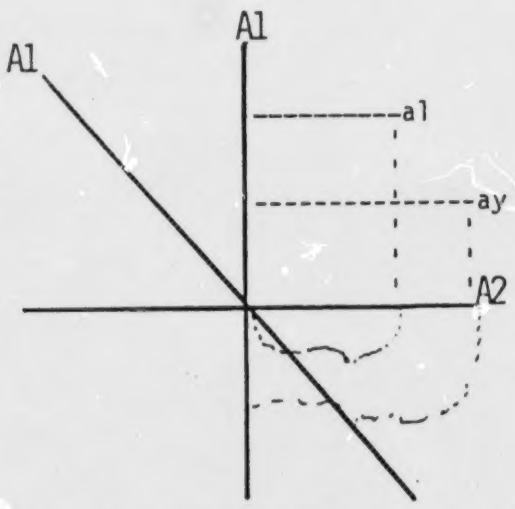
THE PROFILE SIMILARITY COEFFICIENT WAS DEVISED TO COMBINE ALL THREE ASPECTS OF PROFILE SIMILARITY (E.G. SHAPE; LEVEL; AND ACCENTUATION) INTO A SINGLE TOTAL JUDGMENT (CATTELL, 1949). MOREOVER, THE PROFILE SIMILARITY COEFFICIENT CALCULATION IS MADE BY TAKING THE DIFFERENCE (THE INDIVIDUAL SCORES) OF THE TWO GROUP ON EACH VARIABLE IN SUCCESSION, SQUARING THEM AND ADDING THEM TO GIVE THE $[\Sigma D^2]$ IN FIGURE 1:

$$r_p\,(iy) = \frac{E_{\underline{K}} - \sum_{J}^{K} d^2\,(iy)}{E_{\underline{K}} + \sum_{J}^{\underline{K}} d^2\,(iy)}$$

$\underline{K}$ IS THE NUMBER OF DIMENSION INVOLVED IN THE COMPARISON, d IS THE DIFFERENCE, IN SCORE UNITS, BETWEEN THE INDIVIDUALS i AND y ON EACH OF THE SUCCESSIVE DIMENSIONS, AND $E_{\underline{K}}$ IS TWICE THE MEDIAN CHI-SQUARE VALUE FOR $\underline{K}$ DEGREES OF FREEDOM, I.E., $E_{\underline{K}} = \underline{2K}$ WHERE $\underline{K}$ IS THE MEDIAN CHI-SQUARE.

ANY TWO PROFILES MAY BE VIEWED AS HAVING SEPARATE DEGREES OF RESEMBLANCE IN (1) SHAPE, (2) LEVEL, AND (3) ACCENTUATION (STEEPNESS OF PROFILE) OF SHAPE. IF CONFIGURATION IS CONSIDERED INSTEAD OF PROFILES, WE MUST ADD (4) ORDER OF SEQUENCE. THE CORRELATION COEFFICIENT, CANCELING MEANS AND SIGMAS, IGNORES DIFFERENCES IN (2) LEVEL AND (3) ACCENTUATION AND IS AFFECTED BY THE ACCIDENTAL CIRCUMSTANCE OF THE DIRECTION IN WHICH A VARIABLE HAPPENS TO BE CALLED POSITIVE.

THE MEANING OF AN rp OF + 1.0 IS THAT TWO PERSONS OR PATTERNS HAVE EXACTLY THE SAME PROFILES AND FALL ON THE SAME POINT IN A MULTIDIMENSIONAL SPACE, AND AS



A VALUE OF 0 MEANS THAT THEY FALL AS FAR APART AS ONE WOULD (ON THE AVERAGE) EXCEPT FOR ANY TWO POINTS TAKEN AT RANDOM. A VALUE OF -1.0 MEANS THAT THEY ARE AT OPPOSITE ENDS OF THE DISTRIBUTION.

THE PROBLEM OF MEASURING THE RESEMBLANCE OF TWO GROUPS, THEREFORE, BECOMES ESSENTIALLY THE CALCULATING OF THEIR DISTANCE APART IN A DEFINED FACTOR SPACE. THIS CAN BE WRITTEN

$$d_k\,(iy) = \sqrt{\sum_{J=1}^{J=K} (a_{ji} - a_{jy})^2}$$

RESULTS AND DISCUSSION

THE COACHES CLASSIFIED 66 OR 43 PERCENT OF THE 154 HIGH SCHOOL ATHLETES AS SUCCESSFUL FOOTBALL PLAYERS, AND 88 OR 57 PERCENT OF THE SUBJECTS WERE CLASSIFIED AS UNSUCCESSFUL FOOTBALL PLAYERS.

TO ANSWER THE THREE QUESTIONS POSED IN THIS STUDY, THE 17 EXPERIMENTAL VARIABLES WERE SUBJECTED TO CATTELL'S PROFILE SIMILARITY COEFFICIENT CALCULATION. THE RESULTS OF THE PROFILE SIMILARITY COEFFICIENT CALCULATION INDICATED THAT THE TWO GROUPS OF FOOTBALL PLAYERS HAD THE SLIGHTEST DEGREE OF SIMILARITY AS THE COEFFICIENT INDEX OF -.97 WITH 16 DEGREES OF FREEDOM WAS SIGNIFICANT AT THE .01 LEVEL OF CONFIDENCE. THIS RESULT WAS INTERPRETED TO MEAN THAT THE 17 VARIABLES USED IN THIS STUDY WERE EFFECTIVE DETERMINANTS OF THE COACHES' CLASSIFICATION OF SUCCESSFUL AND UNSUCCESSFUL FOOTBALL PLAYERS. THE MEANS AND STANDARD DEVIATIONS FOR THE TWO GROUPS OF ATHLETES HAVE BEEN PRESENTED IN TABLE 1.

TO ANSWER THE SECOND AND THIRD QUESTIONS POSED IN THIS STUDY:

(2) HOW HOMOGENEOUS ARE THE MEMBERS OF THE SUCCESSFUL FOOTBALL ON AN ARRAY OF PHYSICAL AND MOTOR ABILITY VARIABLES?

(3) HOW HOMOGENEOUS ARE THE MEMBERS OF THE UNSUCCESSFUL FOOTBALL PLAYERS ON AN ARRAY OF PHYSICAL AND MOTOR VARIABLES?

A SUMMARY OF THE COMMON MEANS AND GROUP STANDARD DEVIATIONS FOR BOTH GROUP OF ATHLETES ARE PRESENTED IN TABLE 2.

AS SHOWN IN TABLE 2, THE PROFILE-SIMILARITY COMPUTED WITH 17 VARIABLES REVEALED GREATER VARIABILITY BETWEEN THE TWO GROUPS OF FOOTBALL PLAYERS IN HEIGHT, BODY WEIGHT, UPPER ARM GIRTH, CHEST GIRTH, THIGH GIRTH, CALF GIRTH, RIGHT GRIP STRENGTH, LEFT GRIP STRENGTH, BACK LIFT STRENGTH, LEG LIFT STRENGTH, BAR DIPS, 40 YARD DASH, 60 YARD SHUTTLE RUN, TOTAL BODY REACTION,

TABLE 1

GROUP MEANS AND POOLED STANDARD DEVIATIONS
FOR SUCCESSFUL AND UNSUCCESSFUL FOOTBALL PLAYERS

VARIABLES	MEANS		STANDARD DEVIATIONS
	SUCCESSFUL N=66	UNSUCCESSFUL N=88	
1. Standing Height	70.0	69.1	2.74
2. Body Weight	168.6	157.6	24.11
3. Upper Arm Girth	33.1	31.5	3.72
4. Chest Girth	90.4	88.1	8.00
5. Thigh Girth	56.0	53.9	5.32
6. Calf Girth	37.2	35.5	3.00
7. Right Grip	133.5	119.3	19.69
8. Left Grip	122.9	116.2	19.32
9. Back Lift	303.0	272.1	60.68
10. Leg Lift	1162.4	987.1	292.60
11. Bar Dips	11.2	9.8	4.97
12. Forty-Yard Dash	5.0	5.2	0.45
13. Illinois Agility Run	15.1	15.0	2.70
14. Sixty-Yard Shuttle	16.3	17.1	1.13
15. Total Body Reaction	6.4	6.8	0.35
16. Football Throw for distance	43.5	37.3	6.19
17. Standing Broad Jump	102.8	88.9	8.83

TABLE 2
MEANS AND STANDARD DEVIATIONS OF PROFILE ELEMENTS

VARIABLES	COMMON MEANS	STANDARD DEVIATIONS	
		SUCCESSFUL	UNSUCCESSFUL
1. Standing Height	69.5	2.66	2.80
2. Body Weight	162.3	20.51	26.44
3. Upper Arm Girth	32.2	3.20	4.03
4. Chest Girth	89.1	9.00	7.13
5. Thigh Girth	54.8	5.02	5.38
6. Calf Girth	36.2	2.51	3.32
7. Right Grip	125.4	19.02	20.18
8. Left Grip	119.1	18.75	19.73
9. Back Lift	285.3	45.56	65.63
10. Leg Lift	1062.2	267.61	298.80
11. Bar Dips	10.4	4.53	5.27
12. Forty-Yard Dash	5.12	0.40	0.51
13. Illinois Agility Run	15.1	2.72	2.68
14. Sixty-Yard Shuttle Run	16.6	1.10	1.16
15. Total Body Reaction Time	6.7	0.28	0.40
16. Football Throw for Distance	41.4	6.71	7.16
17. Standing Broad Jump	91.6	8.75	8.88

TABLE 3

Significance of Differences Between
Means of Successful and Unsuccessful Football Players

VARIABLES	Successful		Unsuccessful		t	p
	Means N=66	Standard Deviations	Means N=88	Standard Deviations		
1. Standing Height	70.0	2.66	69.1	2.80	2.04	.05
2. Body Weight	168.6	20.51	157.6	26.44	2.91	.01
3. Upper Arm Girth	33.1	3.20	31.5	4.03	2.83	.01
4. Chest Girth	90.4	9.00	88.1	7.13	1.70	NS
5. Thigh Girth	56.0	5.02	53.9	5.38	2.58	.01
6. Calf Girth	37.2	2.51	35.5	3.32	3.65	.01
7. Right Grip	133.5	19.02	119.3	20.18	4.47	.01
8. Left Grip	122.9	18.75	116.2	19.73	2.14	.01
9. Back Lift	303.0	45.56	272.1	65.63	3.06	.01
10. Leg Lift	1162.4	267.61	987.1	298.80	3.66	.01
11. Bar Dips	11.2	4.53	9.8	5.27	2.72	.01
12. Forty-Yard Dash	5.0	0.40	5.2	0.51	1.57	NS
13. Illinois Agility Run	15.1	2.72	15.0	2.68	.90	NS
14. Sixty-Yard Shuttle Run	16.3	1.10	17.1	1.16	.52	NS
15. Total Body Reaction Time	6.4	0.28	6.8	0.04	3.08	.01
16. Football Throw for Distance	43.5	6.71	37.3	7.16	3.40	.01
17. Standing Broad Jump	102.8	8.75	88.9	8.88	4.41	.01

THE FOOTBALL THROW FOR DISTANCE, AND STANDING BROAD JUMP. THE INTERPRETATION OF THIS RESULT WAS THAT THE VARIABLES CONTAINED LESS INTRAVARIABILITY AMONG THE GROUP MEANS FOR THE SUCCESSFUL ATHLETES; WHEREAS, THE UNSUCCESSFUL FOOTBALL PLAYERS HAD DEMONSTRATED MORE INTRAVARIABILITY AMONG THE GROUP MEANS ON EXPERIMENTAL VARIABLES.

PERHAPS, THE REAL DISSIMILARITY BETWEEN THE SUCCESSFUL AND UNSUCCESSFUL FOOTBALL PLAYERS WAS REFLECTED IN THE STRENGTH VARIABLES. TO EXAMINE THIS ASSUMPTION, T-TESTS WERE COMPUTED FOR EACH OF THE EXPERIMENTAL VARIABLE, THE RESULTS OF THE T-TESTS ARE PRESENTED IN TABLE 3.

AS SHOWN IN THE TABLE, 13 OF THE 17 VARIABLES WERE STATISTICALLY SIGNIFICANT BEYOND THE .01 AND .05 LEVEL. THE INTERPRETATION OF THE T-TEST RESULTS WOULD AFFIRM THAT THE ATHLETES ARE SIGNIFICANTLY DISSIMILAR ON 13 OF THE 17 VARIABLES USED IN THIS STUDY.

CONCLUSION

THE RESULTS OF THIS STUDY SUPPORT THE FINDINGS OF SHELLEY, WILEY (1969) AND TALTON (1972), WHO NOTED THAT SUCCESSFUL FOOTBALL PLAYERS WERE TALLER, HEAVIER, AND STRONGER THAN UNSUCCESSFUL FOOTBALL PLAYERS. MOREOVER, THE RESULTS OF THIS STUDY OFFERS A SOLUTION TO THE PROBLEM OF IDENTIFYING SIMILARITIES AND DISSIMILARITIES BETWEEN TWO GROUPS ON AN ARRAY OF VARIABLES.

FINALLY, THE PROFILE SIMILARITY COEFFICIENT OFFERS SEVERAL MAJOR STRENGTHS WHERE IN ASSESSMENT IS TO BE QUANTIFIED. WITH PRUDENT USE, THE PROFILE SIMILARITY COEFFICIENT MIGHT WELL BECOME A POWERFUL TOOL FOR THE PHYSICAL EDUCATOR TO ASCERTAIN RESEMBLANCE AMONG GROUPS ON AN ARRAY OF PHYSICAL AND MOTOR VARIABLES.

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